ANNUAL WATER-WASTEWATER SCHOOL EDITION

Big Sky CLEARWATER

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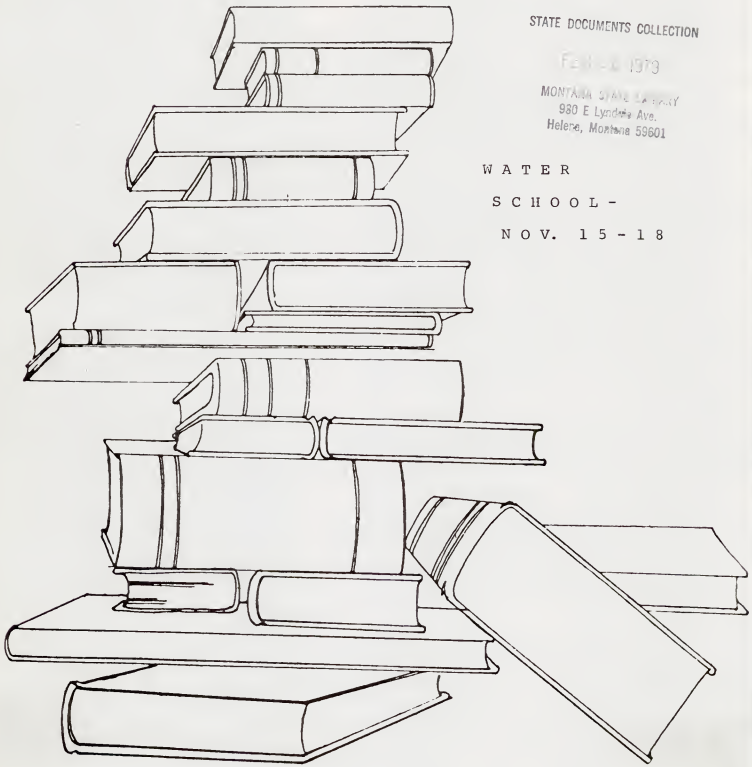

WATER

SCHOOL -

NOV. 15 - 18

43RD ANNUAL WATER/WASTEWATER SCHOOL

The annual water and wastewater operator's school will be held at Montana State University in the Student Union Building during the week of November 15 through November 18, 1976.

As in past schools, the program will include much basic training in the subjects of microbiology, chemistry, hydraulics and mathematics. In addition, there will be many talks on practical operating subjects such as the maintenance of water distribution systems, pump packing demonstrations, water meter calibrations and maintenance, and lagoon operations. An afternoon will be devoted to secondary treatment processes and the land disposal of sewage sludges.

Dr. Al Wallace of the University of Idaho will present a report on rapid infiltration and also on how to handle taste and odor problems in your water supply. Ralph Leidholdt of the Colorado State Department of Health will present a comprehensive discussion of chlorination. Dr. James Smith of Colorado State has done much investigative work in the field of land disposal of sewage and will lead a seminar on that subject. An effort is being made to bring something of real value to everyone.

The annual water school has sometimes been thought of as the place to go to get all the information that one might need to pass a certification examination. It should be emphasized that this is not a "cram" course for certification. Attendance is bound to help those who are new to the business and want to become certified, but the goal of the school is to present both new and old information to operators of the state and not necessarily to produce a class of certified operators.

For the convenience of those attending, the Board of Certification for Water and Wastewater Operators will hold an examination at the end of the school. Due to many requests, the testing will be on Friday instead of Saturday, as has been the practice in the past.

A CITY WITHOUT WATER

What happens when a city of over 200,000 population finds itself without a water supply? On August 31, 1975, the city of Trenton, New Jersey, the capital city of the state, found itself in that position. Causes of the situation and the recommendations of an investigating board are covered in a most interesting report issued by the New Jersey Department of Environmental Protection.

It was Labor Day weekend, 1975. The Trenton water plant was running at a 29 MGD rate and the storage was filling. The day shift operators came on duty and decided that due to the lowered consumption rate of the holiday, they should reduce their pumping rate to 23 MGD. The procedure was a routine one of switching to a lower capacity pump. The pumps were located below ground level on a floor which also served as part of the clear well roof. Each pump had valves on the discharge and suction operated hydraulically by a pressured water supply from a 2½ inch line. They decided to start #4 pump and to shut down pump #2.

At 9:45 a.m., one operator opened the supply valve on the 2½ inch line to #4 pump and put the pump into operation. Shortly thereafter, he signalled to the other operator that the shutdown of pump #2 could be made. The #2 pump stop button was then pushed which should cause the hydraulic discharge valve to close and to start a timer which would turn off the power to the motor driver. The operator watched the discharge valve on #2 slowly close to the half-open, half-closed position and then stop. He made efforts to get the valve to continue closing, but it would not. It was stuck half open. The timing mechanism now cut the power from the #2 pump. The operator then attempted to close the hydraulic suction valve, but it would not operate. Water now started to flow backwards through the pump into the clear well. The senior operator telephoned for help. He tried to operate other hydraulic valves. None would work. The clear well level began to rise. Other pumps began to stop and water flowed backwards through them. They began to

spin backwards, and it was not possible to restart them.

The clear well was now full and water started to gush up through the high level relief vent. The relief vent discharged onto the pump room floor! Now #4 pump stopped. Other personnel arrived. Electric power was disconnected. The superintendent attempted to close two 36-inch gate valves on the discharge header but was unsuccessful. Crews arrived to close two 48-inch valves outside the building. By 1 p.m., one outside valve had been closed and the other partly closed. Pressure inside the clear well increased and finally a hole ruptured in the pump room floor and water filled the pump room to a level of 12 feet before the 48-inch valves were finally closed.

Fire trucks were called to pump the water level down, and it was discovered that the supply valve on the 2½ inch line controlling the hydraulic pressure to the valves on pumps #1, 2, and 3 was CLOSED. That was the reason that they could not be operated.

Flooding of the pump room had soaked the electric motors, and it was necessary to lift them out and take them to a shop for baking and drying. One had to be rewound.

At the time of this incident, the city had approximately 95,000,000 gallons of treated water in its reservoirs. This was roughly a three-day supply. Emergency connections were rigged up through temporary lines, fire hose, and fire engine pumpers. Other interconnections were made with private and public wells and supplies until an emergency total of about 12 to 15 MGD was obtained, but this was less than half the normal consumption. A severe shortage quickly developed. Some low areas of the city continued to receive a trickle of water, but other parts of the city were without water supply for as long as 96 hours. Some customers in higher areas did not have water until September 8. Businesses had to close. The mayor declared an emergency proclamation and all non-essential uses of water were prohibited. State government activities were restricted. Various estimates placed losses at five to ten million dollars.

All water supply was on a "boil water" order and an intensive testing program was established. Chlorination was heavy. Non-essential use of water was prohibited in Trenton for eight days while in some surrounding areas the restrictions on water use lasted for several weeks.

What was the cause? The immediate cause apparently was that someone turned off the hydraulic supply valve to pumps #1, 2 and 3 thereby inactivating the control valves. The investigating board, however, placed a finger of blame on other primary factors. They stated that there are three factors which should be present in a well run water utility: (1) Personnel at all levels who are experienced, properly trained, adequately paid, and selected for ability and knowledge; (2) A governing body or group which is dedicated to the provision of high quality water service and uses sufficient oversight to guarantee such service; and (3) A financial program and rate structure which provides funds needed to properly operate and maintain the system, and provide for extensions and renewals.

What would happen in your city or town if you found yourself faced with a breakdown of equipment, a loss of supply, or other condition which might shut down the supply of water for your system? Is there a booby-trap situation--such as was built into the Trenton plant--that could someday cause you to face this sort of disaster? Can you give positive answers to the statements of condition that the Trenton board posed? Are your people adequately trained to face an emergency? Does your city council or board know and understand your problems and provide you with the cooperation and support you need? Is your rate structure, your budgeting, and your management equal to present and future needs? These are hard questions that face most water system operators and managers, and in most cases, they are difficult to answer.

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IODINATION VS. CHLORINATION

The Office of Water Supply, EPA, sent out a notice on October 15, 1976 relating to their policy on iodination. The position on the use of iodine as a disinfection agent remains unchanged since the policy statement issued in 1973.

Only new developments pertinent to iodination are the proposed use of activated carbon to remove iodine and the discovery of iodinated organic compounds in drinking water or drinking water sources. The possible conversion of free iodine to iodide by activated carbon and the lack of absorption of iodine compounds by the carbon do little to alleviate the potential health problems resulting from iodination. Iodide ions, as well as free iodine, can contribute to the formation of iodinated organic compounds of potential health significance.

There does not appear to be justification for modifying the earlier position. Research on several aspects of iodination are in progress, but until it can be demonstrated that iodination is a safe alternative to chlorination, the EPA position remains that, while iodine can be used for emergency or short term disinfection, it is not recommended for public water supply or general use.

The State Department of Health and Environmental Sciences has approved the use of iodine for road side rest areas and for such establishments catering to the transient public when the permanent employees are aware of the hazards involved with the use of iodinated water. These hazards are the formation of iodinated organics and the dietary effects of iodine on persons with thyroid conditions.

Any questions regarding iodination should be directed to the Department of Health and Environmental Sciences, Water Quality Bureau.

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ACTIVATED SLUDGE SEMINAR HELD

A special training workshop on the Operational Control of Activated Sludge was held at Billings on September 29, 30, and October 1. The program was produced by the State Department of Health and Environmental Sciences, with assistance from the Environmental Protection Agency. The program was based upon a special EPA project which is developing operation and troubleshooting procedures for wastewater treatment plants.

An exceptionally talented staff of experts was obtained to present the material, including Owen Boe, Environmental Engineer for the EPA Region VIII from Denver; Paul Klopping, Instructor in Environmental Science at Linn-Benton Community College at Albany, Oregon; Chuck Zickefoose, Operations Consultant with Stevens, Thompson, and Runyan, Inc. of Portland, Oregon; and John Nelson, Director of Operations at Denver Metro Sewage District in Denver, Colorado. In addition, Bill Pasco of the Silver Bow Metro Sewage District at Butte and Don Noyes of the city of Bozeman wastewater treatment plant assisted. Twenty-seven operators and engineers enrolled in the workshop. Subjects covered included nearly one full day on the Mallory (West) system and ways in which the operations can be followed and guided, the use of other parameters and their relation to sludge control, examples of troubleshooting in activated sludge plants, the use of the microscope as an operating tool and the economics of operating control.

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Some of Murphy's laws -

1. If anything can go wrong, it will, and will happen at the worst possible time.
2. Nothing is ever as simple as it seems.
3. Everything always costs more money than you have.
4. If you try to please everybody, somebody is not going to like it.

PUBLIC WORKS EMPLOYMENT ACT

On July 22, 1976, the Public Works Employment Act of 1976 (P.L. 94-369) was enacted. The purpose of the legislation is (1) to alleviate the national unemployment problem particularly in the construction industry where the unemployment rate is approximately twice that of the national average, (2) to stimulate the economy by assisting State and local governments in the building of necessary public facilities. Generally, the bill would provide 100% Federal grant to State/local governments for construction, repair and other improvements of local public facilities. Grants would be made for public facility projects which can begin quickly to reduce unemployment and stimulate construction and related industries.

State and local governments (which include any city, town, county, parish and other political subdivision of a State and any Indian tribe) may qualify for construction grants under this Act. Construction, repair or other improvements of local public works projects and the completion of plans, specifications and estimates for local public work projects where either architectural design or preliminary engineering or related planning is required to permit construction of the project are eligible for grant funding. In addition, a grant may be made to increase the Federal contribution to a public works project for which Federal financial assistance is authorized or to provide all or any portion of the required State or local share of the cost of any public works project for which financial assistance is authorized under any provision of State or local law requiring such contribution.

These funds may not be used for projects whose principal purpose is channelization, damming, diversion or dredging of any natural watercourse, or the construction or enlargement of any canal or having such as its permanent effect. Neither may the funds be used for maintenance costs. Another important condition is that grants will only be made for such projects for which the applicant provides satisfactory assurances that if funds are available, on-site labor can begin within 90 days of project approval. Priority and perference will be given to public works projects of local governments, particularly in those areas in which the unemployment rates are particularly high or are consistently high.

We bring this to your attention since this Act provides an important source of funding for construction of water treatment and distribution facilities, especially for small communities.

Since the Economic Development Administration, Department of Commerce is administering these funds, your local EDA representative, listed below, can be contacted for more current information.

Ann Rolling
EDA Representative
Medical Arts Building
Butte, Montana 59701
Ph. No. 723-6561-3381

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Thank goodness that Superman can always remember which phone booth he left his pants in!

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THE MAKING OF FRIENDS

If nobody smiled and nobody cheered
And nobody helped us along,
If each every moment took care of himself
And good things went to the strong,
If nobody cared just a little for you
And nobody thought about me,
And we stood alone in the battle of life,
What a dreary old world it would be.
Life is sweet just because of the friends
we have made
And the things which in common we share.
We want to live on, not because of
ourselves,
But because of the people who care.
It's giving and doing for somebody else-
On that all life's splendor depends,
And the joy of this world, when you've
summed it all up,
Is found in the making of friends!

- Edgar A. Guest

SURVEY OF DIRECT FILTRATION PRACTICE

A survey of direct filtration practice has recently been prepared by the AWWA Subcommittee on Direct Filtration, chaired by G. S. Logsdon. Their information was obtained from questionnaires returned from 30 direct filtration plants in the U. S., seventeen of which used granular median filters and 13 which used diatomaceous earth filters. For the purposes of this survey, direct filtration has been defined as "the treatment system in which filtration is not preceeded by sedimentation". The attention of the committee was directed to the direct filtration process by the new EPA drinking water regulations which include a mandatory turbidity limit of 1 TU with provision for a limit of 5 TU under certain circumstances. This standard may very well necessitate the filtration of some waters which are presently being treated by disinfection alone. As the elimination of sedimentation facilities offers a savings in construction costs, direct filtration may be attractive to the water utility planning its first filtration facility. A short summary of the findings of this survey follows.

Granular Media

Response to the questionnaire by plants using granular media showed that pretreatment before filtration varied considerably. Flash mix times varied from 15 seconds to one minute. Floculation, when used, was accomplished by using a series of steps rather than a single step.

It was shown that most plants were operating below the designed filtration rate and that dual media was most commonly used.

In general, the plants appeared to have little difficulty in meeting the 1 TU limit on filtered water turbidity. Four plants reported maximum filtered water turbidities in excess of this but may not have been out of compliance with the drinking water regulations as the 1 TU is for a monthly average and these reports were for an undefined period of time (possibly only part of a day). The survey results seemed to indicate that plants where raw water turbidity rose to a maximum of 300 TU were able to maintain effluent turbidities of 1 TU and below.

It is possible that changes in the criteria for filter operation, backwash and monitoring methods may enable operators to consistently produce 1 TU water. Continuous monitoring with backwash before the 1 TU is exceeded could eliminate the occasional violation of the turbidity limit.

Diatomaceous Earth Filtration

This survey covered diatomaceous earth filter plants which ranged in size from less than 1 MGD to 6 MGD, nearly all of which reported operating at maximum rates of 1.0 gpm/sf or more. The maximum rate for most plants was from 30 to 50 percent above the average rate.

Most of the D.E. filters were package units provided by manufacturers and applied body feed as a slurry rather than by a dry feeder. The largest single units were a 2.5 MGD pressure plant and a 1.5 MGD vacuum plant. Adequate length of filter run is not normally a problem as two thirds of the plant averaged 40 hours or more. Short runs do occur during times of high suspended solids loadings, however.

Data supplied by this survey showed that most D.E. plants are located on waters that are of fairly uniform and high quality. This could be a reflection of regulatory agency policies.

D.E. filters are able to produce waters that meet the 1 TU limit. The majority of those surveyed average 0.6 TU or less. Four plants, however, reported maximum turbidities above 1 TU. All four of these plants treated raw waters with maximum turbidities of 20 - 100. A more detailed analysis of operating data would be necessary in order to determine whether some operating adjustment, such as a finer body feed or a lower turbidity limit for initiation of filter wash, could reduce the maximum turbidities at these plants.

Conclusions

1) Most, if not all, direct filtration plants are apparently meeting the 1 TU limit of the new drinking water regulations. Filtered water was 0.6 TU or less for granular media filters and 0.6 TU or less for D.E. filters at 80% of the plants reporting.

2) The D.E. plants reporting maximum filtered turbidities in excess of 1 TU generally had raw water sources with higher maximum turbidities than D.E. plants always meeting this limit.

3) Consideration should be given to use of direct filtration to treat water of good quality, especially those waters not filtered at the present time.

4) A detailed investigation of the daily operating records of a number of plants, or an extensive pilot plant test, or both, should be conducted in order to ascertain upper limits of raw water turbidity that direct filtration plants can successfully treat.

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Congressman Keith Sebelius was in town the other day and told the tale of two gents discussing what was wrong with our country. The first guy says "the greatest wrongs in our land are ignorance and apathy, don't you agree?" To which the other guy responded, "I don't know, and I don't give a damn!!"

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WATER TANK CLEANING

In recent years, the persons involved in cleaning water tanks have been doing an excellent job and very few complaints have been received by the Dept. of Health and Environmental Sciences. This has not always been so. In the past, some tank servicing companies were highly specialized "rip-off" artists and this type of operator may again be visiting Montana.

Just recently, a town called the Department regarding an out-of-state water tank servicing company that instead of removing the debris from the tank after cleaning and scaling, just put the stuff in the standpipe. Then they failed to remove the material by either opening the bottom hatch or flushing the material out. The water operator inherited the task of getting this crud out of the standpipe.

Some of the problems encountered with tank cleaners in the past were, giving the community a small, or so it seemed, unit price for replacing bolts, rivets, or welds, without an estimate of how many bolts, rivets, or inches of welds would be needed. In some cases, the final bill was for several thousand dollars; and many good serviceable rivets were removed and many inches of unneeded welding was supposedly done.

Generally, the tank servicing companies can do a good job, even those with a questionable reputation, if they are supervised. When they know someone in the city or town is checking on their work, they usually scale the tank, make only needed repairs, paint the tank at the contract price, and get out.

But if the city or town negotiates a contract based on the tank company's estimate of the work needed or signs a contract that is open ended with so much an hour or a low unit price for extra work, they are asking for trouble.

Be sure you know what is actually in the contract before signing. Have your attorney review it. Then sign with the understanding that a local person will oversee the work.

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A hangover is something that happens to a head that wasn't used the night before.

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SACRAMENTO STATE UNIVERSITY OFFERS NEW COURSE ON COLLECTION SYSTEMS

The highly successful correspondence in Operation of Wastewater Treatment Plants developed and conducted by Sacramento State University is well known to treatment plant operators across the nation. Now the same University has developed a course on the sewage collection system. It was prepared by Ken Kerri using a similar format. It is designed to train workers in operation and maintenance of wastewater systems, and it utilized experienced collection system personnel in its development. Topics covered include the reasons for operation and maintenance, inspection, testing, cleaning and maintaining sewers, repairs, lift stations, safety, administration and organization.

This course can furnish comprehensive training to those engaged in sewer maintenance, permitting better service to both employers and to the public.

The time to complete the course depends upon the individual. As with all correspondence courses, a certain self-discipline is necessary to set a regular schedule of study such as one or two evenings every week. Most collection system workers will require from 100 to 150 hours of study to complete the program. At successful completion, the student will receive a certificate from Sacramento State University and will be granted 9 CEU's (Continuing Education Units).

Enrollment, including the study manual, is $55. After the manual is obtained, additional enrollments in the course may be made for $25. If the manual only is desired, the cost is $30.

You can enroll in this course by writing to:

Kenneth Kerri
Department of Civil Engineering
California State University
6000 Jay Street
Sacramento, California 95819

Send your name, address, social security number (used for computer identification) and a check for the amount necessary.

A NEW SELF-STUDY COURSE IN MANAGEMENT

Michigan State University has announced the release of a new correspondence course designed for the "middle managers" of water and wastewater plants and systems. The course, which is named "Supervisory Management in the Water/Wastewater Field," was prepared under a contract with the EPA. This course is for you if you are involved or interested in a water or wastewater system, if you are the operator of a treatment plant, a foreman of a crew, a plant superintendent, a chief operator, or if you are the top manager of a system. It is designed to assist the individual in assuming the middle manager role or to improve your skill as a middle manager.

It covers such material as the function of a manager, the motivation of people, communications and how to delegate authority, how to plan and organize, the staffing and directing of work, controlling and the relations with employees and unions.

The course consists of seven lessons with two supplements. A manual and textbook is supplied. Most students will require four to six months to complete the work. Six CEU's (Continuing Education Units) will be issued upon successful completion of the course.

The course is very inexpensive. A fee of $60 covers the books and correspondence work. After the textbook and manual are obtained with the first enrollment, additional students may be enrolled in the course for $25. For additional information, you may contact Ken Johnston, Training Officer, Water Quality Bureau, Box 307, Avon, Montana 59713.

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Boss: A man who comes to the office late when you are early and early when you are late.

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In 1932 automobile traffic was becoming a problem in Japan. These instructions were given to the motorists of Kobe - and translated into english:

"At the rise of the hand of policeman, stop rapidly. Do not pass him or otherwise disrespect him.

"When a passenger of the foot hove in sight, tootle the horn, trumpet to him, melodiously at first. If he still obstacle your passage, tootle him with vigor and express by word of mouth the warning, Hi Hi.

"Beware of wandering horse that he shall not take flight as you pass him. Do not explode the exhaust box at him. Go soothingly by or stop by the roadside while he pass by away.

"Give big space to the festive dog that make sport on the highway. Avoid entanglement of dog with your spoke wheel.

"Go soothingly on the grease mud as there lurk the speed demon.

"Press the brake of the foot as you roll around the corners to save collapse and tie-up."

All of which sounds like very good advice.

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REGISTRATION OF HOME WATER TREATMENT UNITS

EPA sets the interim requirements for the registration of bacteriostatic water treatment units for home use in Federal Register, Volume 41, No. 152, Thursday, August 5, 1976.

The purpose is to require registration under the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) of certain water treatment units intended for home use. Specifically, those home use water treatment units containing filter media impregnated with silver which is intended to prevent, destroy or mitigate any pests (bacteria) at a recommended lifetime tap water capacity that reasonably could be expected for a single family dwelling.

There are three general types of water treatment units:

1) Water treatment units which are not intended to prevent, destroy, repell or mitigate any microorganisms or other pests. Examples of products in this class are those comprised of activated carbon or coarse filtering material which are intended to remove undesirable chemicals, odors, or particulate matter and with respect to which no expressed or implied claims for pesticidal activity are made. Water treatment units in this class are not subject to regulation under FIFRA.

2) Water treatment units which consist only of a physical means to prevent, destroy, or mitigate microorganisms or other pests in water. Such water treatment units are devices under the meaning of FIFRA, but are not subject to the registration requirements. The sale, distribution, or other movement in commerce of such devices which may be misbranded within the meaning of FIFRA is a violation of the Act.

3) Water treatment units incorporating a substance of mixture of substances including any chemical antimicrobial agent intended to prevent or destroy, or mitigate mircroorganisms or other pests in waters are subject to registration as pesticides under the FIFRA. The administrator of EPA is required to find that the pesticide in effective for use as set forth on the label and that the pesticide will not generally cause unreasonable adverse effects on the environment when used as directed. The burden of proof with respect to each of the required findings is on the applicant. Home use bacteriostatic water treatment units with filtering media impregnated with silver which is intended to serve as a bacteriocide are included and are subject to registration. The pesticide in such units is of necessity incorporated to negate the potential problem created by the primary use of the prod-

uct which is removal of undesirable substances such as chemicals, odor, color, and particulate matter from municipally treated or other treated potable water.

Since the basic purpose for the home use water treatment units addressed in this policy statement is to achieve benefits other than pesticidal anti-microbial benefits, the pesticide claims permissible on the labelling and/or advertising must be quite limited and explicit. The following pesticidal claims are considered to be the maximum warranted for products of this type: 1) Inhibits the growth of bacteria within the filter unit; 2) Contains a bacteriostatic filter; 3) Provides bacteriostatic activity within the filter unit. Any claims to these products as a water purifier constitutes a false or misleading claim. They may be represented as water treatment units, water clarifiers, water filter, or water deodorizers, or similar names which do not in any way imply water purification. Claims of value which are considered to be nonpesticidal must also be supported by adequate evidence. Such claims include the following will be removed from water:

1) Halogenated volatile organics (must be specific); 2) Various pesticides (must be specific); 3) Metals (must be specific); 4) Turbidity; 5) Chlorines. Bacteriostatic water filtering units are designed to act only on bacteria contained in potable water which is microbiologically safe for drinking. Accordingly, claims will not be accepted for use of these units on polluted well water or well waters. Moreover, the direction for use must clearly reflect that the product is only intended for use on potable water which is microbiologically safe for drinking.

Should any water users in the cities and towns of Montana inquire regarding the use of home water treatment units, they should be informed that if they have any questions concerning the proposed device, they should contact either the State Department of Health and Environmental Sciences or the EPA Regional Office in Denver.

CARE OF ELECTRIC MOTORS

Every water and wastewater system uses electric motors to drive pumps and other machinery. The care of those motors is very important to the operation of that system. Here are a few causes of motor troubles and some ideas on how to protect against motor failure.

MOISTURE: Unless your motor is specially built to withstand water, the presence of excessive moisture can deteriorate the insulation on windings and can hold acid or alkaline fumes such as hydrogen sulfide, chlorine or ammonia to attack your motor. Make sure that motors are in a ventilated location, that they are not subject to drips, splashing, leaks, etc., and that high humidity does not cause condensation in a standby or idle motor.

DIRT: A motor that is not periodically cleaned will collect dirt and dust in its open spaces causing a reduction in the cooling. Dirt can cause sparking in commutators and brushes if the motor is so equipped. Dirt can lead to shorting. Be especially careful that grease or oil is not allowed to collect to hold the dirt. Clean motors with a cloth, blow out the dust and dirt with clean, dry air pressure. A high flash solvent such as kerosene (never gasoline) can be used to clean oil and grease, but do not get it on the windings.

VIBRATION: Motors should run smoothly. Vibration can cause failure of connections, cause bearing wear, and may even eventually crack castings. Vibration is easy to feel and is often caused by poor alignment with the driven shaft of the pump or other equipment. It may also be a symptom of bent shaft, loose mounting, or bad bearings. Vibration is a signal that maintenance is needed.

OVERLOADING: A change of conditions on a pump may put a motor into an overloaded condition (Reduction of discharge head may increase pumped volume and increase motor loading, for instance). Overloading can be detected as increased temperature and an increase in amperage drawn. If a

motor is running hot, or if it kicks circuit breakers, be suspicious that it is overloaded. A motor running at higher than design temperature will have a shortened life. The load on a centrifugal pump motor driver can be reduced by partly closing the discharge valve, but do not close down on a positive displacement pump such as a plunger diaphragm or progressive cavity type of pump.

IMPROPER LUBRICATION: Follow the manufacturer's instructions carefully in regard to lubrication. Over-oiling or over-greasing can be harmful. Do not lubricate while the motor is running. Be careful that oil does not reach motor windings. Keep a record of lubrication on every motor.

OPERATE THE STANDBY: If you have spare pumps or standby equipment, put them into operation at regular intervals. Make sure that a standby will operate properly so that you are not caught with a non-operational piece of equipment on the day that you badly need it. Regular operation will dry condensation out of motors, distribute lubricants and keep the unit in operating condition. Many operators use a rotation of equipment to equalize the usage.